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PSYCHOLOGICAL ATTRIBUTES CRITICAL TO THE PERFORMANCE OF MQ-1 PREDATOR AND MQ-9 REAPER U.S. AIR FORCE SENSOR OPERATORS

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Remotely Piloted Aircraft (RPA) operations in Iraq, Afghanistan, and other areas of operation are escalating as the force protection capabilities of such aircraft are fully realized in surveillance, reconnaissance, and precision-strike operations. Never in the history of warfare have uninhabited vehicles assumed such a critical role in such a vast array of theater operations. As a result, the aircrew of RPA aircraft work around the clock to provide support capabilities, flying one of the world's most advanced aerial weapons systems. However, there is minimal research on the assessment and selection of enlisted aircrew (i.e., Sensor Operators, SOs) who fill a critical role. At the present time, there are no published studies on the critical attributes of successful MQ-1 Predator and MQ-9 Reaper SOs. The purpose of this study was to consolidate data from several subject matter experts regarding the attributes needed to successfully complete training and adapt to operational demands. The results of the study aim to increase understanding of specific psychological attributes critical to performance, and to improve aeromedical assessment and selection procedures.

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Psychological Attributes Critical to the Performance of MQ-1 Predator and MQ-9 Reaper U.S. Air Force Sensor Operators

INTRODUCTION

Recognizing the significant capabilities of U.S. Air Force (USAF) remotely piloted aircraft (RPA), the USAF is fully committed to increasing and expanding such operations across theaters of conflict (i.e., Iraq and Afghanistan) and in areas of national interest (i.e., Africa). Among the variety of USAF RPAs, the MQ-1 Predator and MQ-9 Reaper airframes have emerged as the most dominant weapons bearing platforms in support of aerial surveillance, reconnaissance, and close air support operations. Although RPA pilots are central to flying, they rely greatly upon sensor operators (SOs) to ensure safe and effective identification, surveillance, targeting, weapons deployment, and battle damage assessment of enemy combatants and assets. A comprehensive MQ-1 Predator SO job analyses has been conducted (Nagy, Eaton, & Muse, 2006), a human performance model of RPA SOs has been proposed (Petkosek, Warfield, & Carretta, 2005), and formal SO training plan has been developed (Department of the Air Force, 2009) to illuminate the significant demands associated with SO duties. However, there is no clearly established list of inherit psychological attributes identified as critical to training, skill acquisition, and adaptation to the RPA platform. The identification of a core set of psychological attributes is essential to identifying airmen who are suitable for operations and who are likely to adapt and thrive in such a unique and critical role.

To fill in this gap, the authors of this study conducted several standardized individual interviews and a held a formal meeting with a large panel of RPA MQ-1 Predator and MQ-9 Reaper subject matter experts (line commanders, pilots, and sensor operators) from training and operational squadrons. The duties of SOs were reviewed and the perceived psychological attributes critical to performance for this position were discussed. The results of the study were consolidated with the findings from existing RPA research literature to develop an organized list of psychological attributes perceived as critical to performance.

Brief Description of the MQ-1 Predator and MQ-9 Reaper

The MQ-1 Predator is a medium altitude RPA developed by General Atomics Aeronautical Systems in response to demand from the military and Central Intelligence Agency (CIA) for a quiet, versatile, unmanned reconnaissance aircraft. Originally labeled RQ-1, the Predator was renamed MQ-1 in 2005 when it was fitted with laser-guided missiles, expanding its strategic role from surveillance and reconnaissance to a precision strike, close air support fighter. It is piloted remotely from the ground, and unarmed versions have been in use since 1994. However, after the terrorist attack on the World Trade Centers in New York, 11 September 2001, Predators were deployed and utilized in-theater over Afghanistan. Although most MQ-1 Predator flights are conducted by the USAF in support of operations in theater, other government agencies such as the CIA and the United States Border Patrol have also acquired and utilize the Predator.

The MQ-1 Predator RPA crew consists of a ground-based pilot who controls the movement of the vehicle, an enlisted sensor operator in charge of reconnaissance and targeting, and a mission intelligence coordinator for communicating and relaying key sources of information. The MQ-1 Predator is equipped with highly advanced computer-based technology for flying. A notable aspect is the ability of the crew to control the aircraft from the ground several hundred miles away. The aircraft is equipped with full-motion video cameras for use in day and night, and variable weather conditions. It is also fitted with a highly advanced targeting system for precision strike capabilities for moving and fixed targets. Weapons armament consists of two laser-guided AGM-114 Hellfire anti-tank missiles. The MQ-1 Predator is 27 feet long, 6.9 feet tall, with a wingspan of 48.7 feet, and may be disassembled for transport. Its wingspan is slightly longer than an F-15E Strike Eagle and roughly the length of a Cessna 172 civilian aircraft. It travels at high rates of speed and can loiter over a target for up to 24 hours. It has an operational ceiling of 25,000 feet (Drew et al., 2005).

The success of the MQ-1 Predator in close-air support and other precision strike missions fostered demand for the MQ-9 Reaper. This airframe is a more robust RPA developed for "hunter-strike" missions. The MQ-9 Reaper flies higher, faster, and is more heavily armed and versatile than the MQ-1 Predator. The MQ-9 Reaper is roughly the size of an F-16 fighter with a length of 40 feet and a height of 16 feet. It can carry a significant weapons payload, and (depending on weapons configuration) can remain in flight for 42 hours. It is also crewed by a ground-based pilot, sensor operator, and mission intelligence coordinator. The MQ-9 Reaper may be armed with up to 8 AGM-114 Hellfire missiles, or it may be configured to carry four 500 pound GBU-12 Paveway II laser-guided bombs, or two GBU-38/B Joint Direct Attack Munition (JDAM) bombs. It may also be configured to carry other weapons (i.e, AGM-65 Maverick air-to-surface missiles, AIM-9 Sidewinder air-to-air missiles, and AIM-120 Advanced air-to-air missiles). The versatility in weapon's configurations provides flexibility to air combatant commanders and ground units requesting assistance. The MQ-9 Reaper can be equipped with a variety of sensors and cameras, dependent upon the mission, and is controlled from the ground in a fashion similar to the MQ-1 Predator. It also carries Synthetic Aperture Radar (SAR) allowing it to target and observe points of interest in the ground, even when such targets are obscured by poor weather conditions. It can loiter over a target for several hours and travel at high rates of speed. The MQ-9 Reaper represents a significant evolution in RPA technology and weapon's deployment (Wilson, 2007).

RPA Role as a Force Multiplier to USAF Operations

Since the onset of Operations Enduring Freedom and Iraqi Freedom, RPAs have served multiple roles in the gathering of imagery and streaming video to support intelligence, surveillance, reconnaissance (ISR), close air support, and various precision strike operations. The "real time" information obtained from RPA operations in theaters of conflict is quickly provided to commanders for identifying fixed and moving targets, tracking enemy movements and assets, as well as surveying battle damage after the deployment of weapons. USAF leadership lauds the role of RPA airframes not only as force multipliers, but as transformational systems with the potential to operate autonomously while shielding aircrew from the traditional threats to personal safety (Stulberg, 2007).

Over the last decade, USAF leadership has spearheaded efforts to rapidly increase RPA capabilities to fully maximize the strategic role of such airframes in "dull, dirty, and dangerous" missions (Nodine, 2009). The "dull" missions are the ones that require long loiter time and constant surveillance of a target (e.g., days to weeks) too tedious for a crew in a manned aircraft to execute without

significant degradations in performance. The "dirty" missions are the ones used for sampling areas for hazardous airborne material, such as the aftermath of a chemical, biological, radioactive and nuclear weapons attack. And finally, the "dangerous" missions are the ones that place a great deal of risk on the survivability of a manned aircraft and its crew. For example, the threat of being killed by enemy air defenses while engaged in close air support operations where the costs of failure is high.

As noted previously, the MQ-1 Predator and MQ-9 Reaper have emerged from strictly ISR assets to become invaluable combat weapon systems (Stulberg, 2007). Due to their success, the Department of Defense budget allocations for RPA technology have exceeded requested amounts, with the goal of expanding the RPA inventory to include larger and more lethal follow-on systems (U.S. General Accounting Office, 2006). It stands to reason that the increased acquisitions budget and devotion to further RPA development will likely result in RPA operations dominating the battle space in the 21st century. The roles of RPAs are expected to expand to a myriad of missions, including transportation of personnel and equipment, as well as aeromedical evacuations (Department of the Air Force, 2005; Department of Defense, 2009; Deptula, 2009)

The USAF has increased the number of operational MQ-1 Predator and MQ-9 Reaper squadrons operating globally. These squadrons are spread throughout Air Combat Command (ACC), Air Force Special Operations Command (AFSOC), as well as the USAF Reserves (USAFR) and the Air National Guard (ANG). At the present time, the largest number of operational RPA squadrons is active duty units within ACC and AFSOC. In an effort to build upon the force structure of Predator and Reaper operations, the Chief of Staff of the USAF (CSAF) has requested several hundred additional RPA pilot and SO positions be added to the current crew member inventory over the next few years.

Duties of the MQ-1 Predator and MQ-9 Reaper Sensor Operator

In general, RPA SOs employ airborne sensors in manual or computer-assisted modes to actively and/or passively acquire, track, and monitor airborne, maritime and ground objects, enemy combatants, and assets. They conduct operations and procedures in accordance with Special Instructions (SPINS), Air Tasking Orders (ATO) and Rules of Engagement (ROE). They assist RPA pilots through all phases of aircraft employment to include mission planning, flight operations, and debriefings. Specific duties include: (a) conducting reconnaissance and surveillance of potential targets and areas of interest; (b) detecting, analyzing, and discriminating between valid and invalid targets using synthetic aperture radar, electro-optical, low-light, and infrared full-motion video imagery, and other active or passive tracking systems; (c) assisting in air navigation, Air Order of Battle (AOB) integration, fire control planning, and determining effective weapons control and delivery tactics to achieve overall mission objectives; (d) receiving target briefs for weapons delivery and conducting immediate first phase Battle Damage Assessments (BDA) for coordination and potential re-attack; (e) utilizing laser target marking systems to provide target identification and illumination for weapons delivery, and weapons guidance; (f) performing pre-flight and in-flight mission planning activities in accordance with unified combatant command and theater rules of engagement; (g) understanding tactics, techniques, and procedures (TTPs) for friendly and enemy AOB assets; (h) operating mission planning ancillary equipment to initialize information for download to airborne mission systems; (i) receiving, interpreting, extracting, and disseminating relevant ATO, Airspace Control Order (ACO) and SPINs information; (j) participating in post-flight debriefing to establish mission accomplishments and potential procedural development; (k) researching and studying target imagery, friendly and enemy orders of battle, as well as offensive and

defensive capabilities from various sources; and lastly, (l) assembling target information, locating forces, and determining hostile intentions and possible tactics (Department of the Air Force, 2009).

As can be surmised from the information outlined above, this enlisted aircrew position requires a person to visually discriminate and synthesize various images and complex data on several electronic screens while maintaining heightened vigilance to numerous sources of visual and auditory information necessary for sustaining situational and spatial awareness. For example, the SO must effectively attend to the electronic video information to calibrate instruments and distances of specific ground objects while maintaining vigilance to visual and auditory input from aircrew and command. The SO must also effectively communicate with other aircrew to report the identification and discrimination of targets and to assist in the deployment of weapons. The SO must also sustain visual targeting during and following the employment of weapons to ensure accuracy. This includes visually observing the destruction of fixed (such as buildings) and moving objects (such as cars), as well as the wounding and death of human combatants. The SO must be attentive to several procedural checklists and processes with advanced computer systems while simultaneously translating two-dimensional information from video screens into three-dimensional spatial imagery. As noted above, the SO must carry out his or her duties in a confined environment with specific rules of engagement, tactics, and techniques.

Please see Nagy et al. (2006) for a more in depth view of the specific job tasks of SO duties, and and Department of the Air Force (2009) for a more detailed description of the SO training requirements. Figure 1 has a simplified breakdown of major workflow tasks for Predator SOs.

Although the risk to personal safety has been removed due to the unmanned (uninhabited) nature of MQ-1 Predator and MQ-9 Reaper operations, the monotonous nature of the work that is interrupted by unpredictable and intense moments of combat can be both mentally and physically fatiguing. Despite the potential for fatigue, the SO must quickly and efficiently monitor and respond to multiple visual and auditory sources of communication with the pilot, mission intelligence coordinator, ground forces, and other aircrew (manned and unmanned) without degradation in performance. The duties of an SO are clearly high demand and high precision where mistakes can come at a significant risk to the lives of others, military operations, national security, and international relations. Understanding basic principles of aviation, crew resource management, communication protocols, geo-spatial mapping, imagery and full motion video analysis, as well as principles of reconnaissance, targeting and weapons deployment are key components to SO duties. However, SOs are also faced with the highly unique challenge of providing continual support to combat operations in theaters of conflict while living and working in a peaceful environment and fulfilling domestic roles (i.e., spouse and parent) and responsibilities. Adapting to the RPA platform requires effective integration of their role as a war fighter with their personal lives.

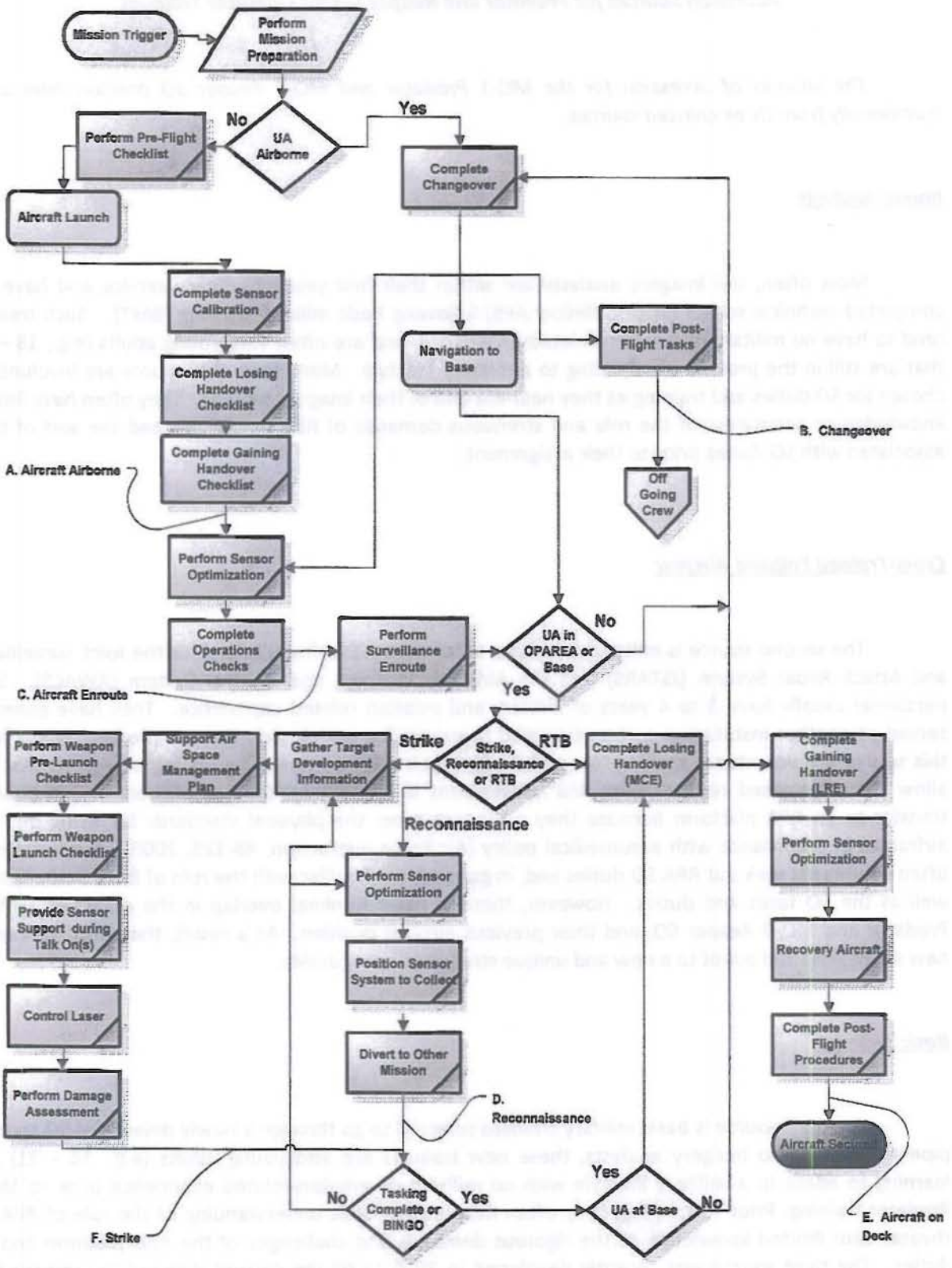

Figure 1. MQ-1 Predator SO workflow diagram adapted from Nagy et al. (2006).

Accession Sources for Predator and Reaper Sensor Operator Trainees

The sources of accession for the MQ-1 Predator and MQ-9 Reaper SO position have come traditionally from three enlisted sources.

Image Analysts

Most often, the imagery analysts are within their first year of military service and have just completed technical school (at Goodfellow AFB) following basic military training (BMT). Such trainees tend to have no military or aviation related experience, and are often very young adults (e.g., 18 – 21) that are still in the process of adjusting to a military lifestyle. Many from this source are involuntarily chosen for SO duties and training as they near the end of their imagery training. They often have limited knowledge or awareness of the role and strenuous demands of RPA operations and the sort of tasks associated with SO duties prior to their assignment.

Cross-Trained Enlisted Aircrew

The second source is enlisted SOs from other manned airframes, such as the Joint Surveillance and Attack Radar System (JSTARS) and the Airborne Warning and Control System (AWACS). Such personnel usually have 3 to 4 years of military and aviation related experience. They have generally served at another installation and participated in supporting aerial operations in theater. Many from this source are volunteers seeking to expand upon their military career by finding a position that will allow them increased responsibility and involvement in combat operations. Others may choose to transfer to an RPA platform because they no longer meet the physical standards for flying manned airframes in accordance with aeromedical policy (Air Force Instruction, 48-123, 2009). These trainees often voluntarily seek out RPA SO duties and, in general, are familiar with the role of RPAs in theater, as well as the SO tasks and duties. However, there is often minimal overlap in the duties of a MQ-1 Predator and MQ-9 Reaper SO, and their previous aircrew position. As a result, they must re-learn a new set of skills and adapt to a new and unique strenuous set of duties.

Basic Trainees

The third source is basic military trainees selected to go through a newly developed SO training pipeline. Similar to imagery analysts, these new trainees are also young adults (e.g., 18 – 21) just learning to adapt to a military lifestyle with no military or aviation-related experience prior to MQ-1 Predator training. Prior to training, they often have only a basic understanding of the role of RPAs in theater with limited knowledge of the rigorous demands and challenges of the RPA platform and SO duties. The third source was recently developed in 2009 to fill the current demand to increase RPA operations in theater. Regardless of the accession source, many of those selected for SO training have limited knowledge of the RPA platform and its unique demands and stressors prior to training.

The accession sources of young airmen that are new to the military and pressed through a condensed SO training program (i.e., less than 6 months) elevates the need for identifying airmen with psychological attributes and characteristics that are well-suited for the training and operational demands of such a unique, stressful, and complex weapons bearing ISR platform. The need for selecting airman with the proper psychological attributes is also accentuated by the increasing dependence on RPA operations in theater. This has raised concerns regarding the potential for jeopardizing the integrity of military operations by not adequately selecting for and training our RPA operators (Nodine, 2009).

Brief Review of Sensor Operator Training Program

Following basic military training, new enlisted recruits (as well as enlisted airmen cross-training from a non-aircrew career field) enter the Air Crew Fundamentals Course (AFC) at Lackland AFB. *See Figure 2.* This course is 12 to 14 trainings days and addresses topics such as aircrew publications, aircrew mission, training issues (qualification, continuation and evaluations), flight medicine topics, basic aerodynamics of flying (to include fixed and rotary wing aircraft flight controls, instruments, weight, balance), as well as topics in aircrew coordination (e.g., crew resource management and situational awareness).

Following AFC, all enlisted airmen (to include those cross training from another aircrew career field) enter the Basic Sensor Operator Course (BSOC) at Randolph AFB, TX. This course is approximately 20 training days addressing initial skills training. BSOC utilizes technical training curricula derived from the Imagery Analysis Apprentice Course, AC-130 Gunship Sensor Operator Course, and Basic Airborne Operations Course (BAOC). The course addresses issues in: intelligence, surveillance, and reconnaissance (ISR), imagery and full motion video analysis, geospatial information and mapping fundamentals, imagery and video analyses of surface features and structures, electronics and missile systems, land, sea, and air order of battle topics, weapon systems and targeting, and training in aviation fundamentals.

The BSOC course is followed by the Unmanned Aircraft Systems Fundamentals Course (UFC) at Randolph AFB, TX. This course is approximately 20 training days focusing on simulator training and the development and refinement of crew resource management skills. This course entails training alongside RPA pilot trainees to facilitate the development of crew interaction and communication skills.

After the UFC course, training candidates are sent to the MQ-1 Predator Sensor Operator Initial Qualification training (SOIQ) at either Creech AFB or Holloman AFB. This training lasts approximately 45 days where they conduct several training sorties, undergo "check rides" to gauge their progress, and receive additional academic instruction.

Following the SOIQ course, they are sent to Combat Mission Readiness (CMR) training for the next 3 months. This training occurs at the operational units to which they are assigned. During this time, they are supervised, provided additional instruction, and check rides. However, they are operating MQ-1 Predators in "real world" operations in theater at this time. They receive individual supervision and are rated on various factors of performance. After 90 days of CMR training, they are expected to be fully capable of independently managing the nature and rigors of their SO duties. *For a more in-depth review of the SO training program, see the career field education and training plan (Department of the Air Force, 2009).*

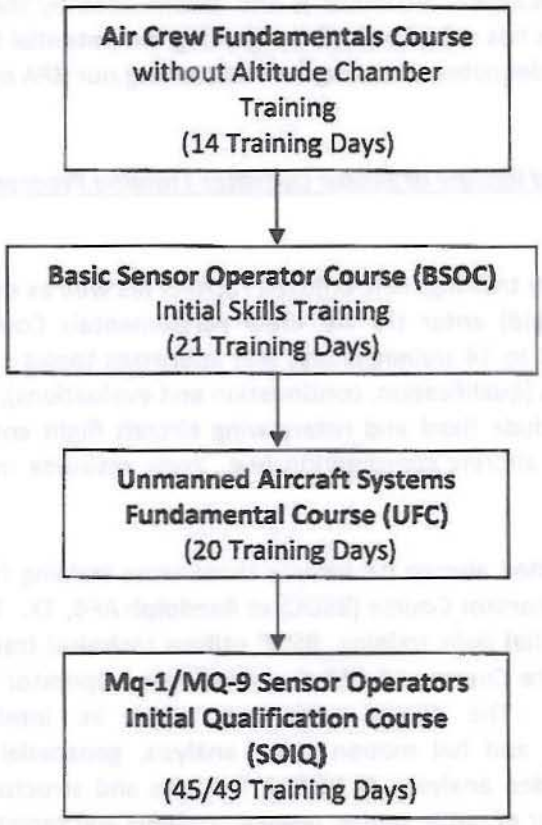

Figure 2. RPA sensor operator training pipeline.

Research on Related AC-130 (Precision Strike) Sensor Operators

It is important to note, that SOs from the AC-130 Gunship share similar full motion video duties. Similar to MQ-1 Predator and MQ-9 Reaper SOs, they provide a pivotal role in supporting ground troops regarding reconnaissance, surveillance, and precision strike aerial operations in theaters of conflict. The general difference is that AC-130 Gunship SOs must be physically resilient to airsickness and face inherent dangers associated with operating in an aerial environment where risk to personal safety is a very elevated concern (e.g., flying under difficult conditions in a hostile territory with exposure to enemy anti-aircraft artillery).

Not all airmen are suited for the demands of such a critical position. A study by Chappelle, Patterson, Sowin, and Randall (2009) resulted in the identification of 19 attributes reported by subject matter experts (SMEs) as critical to training and operational performance. The attributes were organized into six key domains: (a) physical health & fitness- (e.g., freedom from significant medical

injuries or illness, resilience to motion sickness); (b) effective intelligence & cognitive ability- (e.g., high level of general cognitive ability, speed and accuracy of information processing, and visual-spatial aptitudes); (c) emotional stability- (e.g., high levels of emotional composure, poise, and resilience to stress); (d) interpersonal traits- (e.g., high levels of humility, assertiveness, strong drive to achieve and succeed, as well as persevere through challenges); and (e) motivation- (e.g., strong occupational interest in aircrew duties, as well as a belief system compatible with the deployment of weapons. Airmen selected for AC-130 SO training who struggled in one or more areas above, in general, failed training or had significant operational problems and were removed from the career field following training. Those who possess both breadth and depth of such attributes above, in general, performed well. It is unclear, how much the attributes of AC-130 Gunship SOs correlate with the acquisition of knowledge and skills for MQ-1 Predator and MQ-9 Reaper SOs. It is likely, because of the overlap in duties, there will be an overlap in attributes. For example, many of the SO instructors from the AC-130 Gunship SO training program reported a high level of overlap in the visual-spatial analysis of imagery and full motion video duties, as well as crew resource management tasks of RPA SO duties.

Purpose of the Study

As mentioned previously, the purpose of this study is to consolidate the findings of existing RPA research on SO duties with the input of subject matter expert (SME) line operators (i.e., Squadron Commanders, Pilots, and SO instructors) to identify psychological attributes perceived by SMEs as critical to successful skills acquisition in training and operational performance.

METHOD

Participants

A total of 69 experienced RPA operators participated in this study from ACC and AFSOC installations. There were 47 MQ-1 Predator and MQ-9 Reaper pilots (including Squadron and Flight Commanders, as well as Standards and Evaluations Officers) who had cross trained from manned airframes (e.g., tanker/transporter, fighter/bomber, surveillance/reconnaissance aircraft). There were 16 SOs who had come from imagery analyst training or who had cross-trained from another enlisted aircrew position. There were six mission intelligence coordinators that participated in a multidisciplinary group discussion. Reported time on station for operators ranged from 12 months to five years. Additional demographic information, such as age, gender, and ethnicity was not recorded in order for participants to have a high level of anonymity that would maximize genuine disclosure.

The purpose and methodology of the study was granted exemption from the Institutional Review Board (IRB) within the Air Force Research Laboratory (AFRL) at Wright Patterson Air Force Base (WPAFB) and assigned protocol number F-WR-2009-0047-E.

Procedure

Phase 1: Literature Review

Queries of the professional literature were made utilizing data bases in technical and behavioral sciences. The queries of the literature involved identifying official technical reports, peer reviewed journal articles, and scientific texts regarding information relevant to the job tasks and duties of RPA SOs. The literature review entailed usage of various key words (e.g., sensor operator, crew member, etc) and phrases (e.g., psychological attributes, performance, duties, tasks, etc.) to maximize identification of relevant articles. Data bases queried included: Department of Defense Technical Information Center (DTIC), Psychlit, and Medline. The professional literature revealed only a handful of articles directly related to MQ-1 Predator and MQ-9 Reaper SOs (e.g., Air Force Research Laboratory, 1998; Bailey, 2008; Department of the Air Force, 2009; Biggerstaff, Blower, Portman, & Chapman 1998; Kay et. al., 1999; Nagy et al., 2006; Pavlas, et al., 2009) The articles were read and a list of attributes that were directly stated or implied was developed to be cross-checked with input from interviews with SMEs.

Phase 2: ACC and AFSOC RPA SME Operator Interviews

Command Interviews. The Wing and Vice Wing Commanders (CCs) from an ACC installation were interviewed by the research team regarding their perception of the role of RPA Predator and Reaper operations and the attributes for success. Furthermore, the Vice Wing CC demonstrated pilot and SO duties via 45 minutes of simulator training and discussion. The simulator training included

review of procedures for flight, identification and targeting of enemy assets and combatants, the employment of weapons to destroy such targets, battle damage assessment, crew resource management tasks, as well as protocols for aircraft transition to and from launch and recovery crews.

The Squadron Directors of Operations (DOs) from four separate MQ-1 Predator and MQ-9 Reaper squadrons at an ACC installation were interviewed individually by the research team. In addition to a general discussion, they were asked a series of standardized questions (See Appendix A).

The Squadron CCs from two separate MQ-1 Predator and MQ-9 Reaper Squadrons at an AFSOC installation were interviewed by research team members in individual 2-hour group discussions. Similar to the interviews with Squadron CCs at an ACC installation noted above, the discussions were a review of the unique platform of RPA Predator and Reaper operations, the stressors and job requirements associated with such operations, and how they were distinguished from various USAF manned aircraft operations. Discussion also entailed a review of critical SO duties and cognitive aptitude and character traits they considered critical to adapt and thrive in the RPA platform.

RPA Pilot Interviews. A total of three RPA pilots from two separate MQ-1 Predator and MQ-9 Reaper squadrons at an ACC installation and three RPA pilots from an MQ-1 Predator Squadron at an AFSOC installation who had cross trained from previous manned airframes (i.e., fighter, bomber, tanker, transport, surveillance) and had been on station for at least two years with significant experience were interviewed individually. A total of three RPA pilots from an ACC installation who also had cross trained from manned airframes (i.e., fighter, bomber, tanker) and been on station at least one year were interviewed as a group. In addition to a general discussion during individual and group interviews, there were a series of standardized questions (See Appendix A).

Sensor Operator Interviews. A total of three RPA SOs from two separate MQ-1 Predator squadrons at an ACC installation who had been assigned to RPA SO duties following imagery analyst training at Goodfellow AFB and who had been on station at least two years were interviewed individually. A total of three RPA SOs from an MQ-9 Reaper squadron who had cross-trained from previous aircrew career fields (i.e., flight engineer and airborne mission systems) and who had been on station at least one year were interviewed together in a focus group. In addition to a general discussion during individual interviews and group discussions, there were a series of standardized questions (See Appendix A).

Multidisciplinary Group Interviews. A large multidisciplinary group (from an ACC installation) composed of Squadron CCs four separate MQ-1 Predator and MQ-9 Reaper squadrons along with six RPA pilots who had cross-trained from manned airframes, four sensor operators (two who had come from image analyst training and two had cross trained from another enlisted aircrew position) and four mission intelligence coordinators were available for a two-hour group discussion with research team members. All members had been on station for at least one year. The discussion was a review of the unique nature of RPA operations, the stressors and job requirements associated with such operations, and how they were distinguished from various USAF manned aircraft operations. Discussion also entailed a review of the differences between SOs trained in intelligence and imagery analyses from those who cross-trained from other airframes (i.e., JSTARS and AWACS).

A total of two multidisciplinary RPA aircrew groups at an ACC installation from an MQ-1 Predator squadron (composed of a mission intelligence coordinator, three RPA SOs, and a RPA pilot) and a multidisciplinary RPA aircrew group at a MQ-1 Predator Squadron at an AFSOC installation (composed

of a mission intelligence coordinator, a RPA SO and a RPA pilot) who had been on station for at least one year met with research team members. They discussed the nature of their positions, stressors and demands of the position, as well as attributes important to crew resource management.

Simulator Observation and Instructor Interviews. The research team spent a total of four hours of observation and instruction with civilian and active duty pilot and SO instructors from a MQ-1 Predator training squadron at an ACC installation. During this time, researchers met with instructors to observe training scenarios and discuss the psychological attributes needed to successfully pass training and respond to various operational scenarios. A total of two RPA pilot flight CCs, and two instructor SOs were interviewed individually and three instructor pilots were interviewed as a group. In addition to a general discussion during individual and group interviews, they were asked a series of standardized questions. (See Appendix A).

Phase 3: Consolidation of SME Interviews to Develop List of Attributes

The notes from each research team member were consolidated into a list of attributes described by operators as critical to performance. The initial list from review of the literature and SME interviews was composed of over 130 attributes or general descriptors relevant to the performance of SO duties. Descriptions that appeared to label the same or similar attribute were consolidated. The list was then revised again to remove redundancies and attributes with significant semantic overlap. Researchers then distinguished those attributes that appeared to be the result of knowledge and skills developed from (or a product of) training. Finally, those descriptors that were not described as "necessary and critical" by at least three of the four different groups interviewed (e.g., Sq CCs and DOs, instructors, RPA pilots, and SOs) were removed from the list. The remaining list of 21 attributes was then theoretically organized by two aeromedical psychologists from the research team into: (a) physical health, (b) cognitive aptitude, (c) personality traits, and (d) motivation. The organization of the attributes were done in such a way to enable comparison with tables from other studies listing critical psychological attributes of special duty military personnel (e.g., Picano, Williams & Rolland, 2006).

Phase 4: SME Validation of Attributes

The attributes were then discussed individually with 13 MQ-1 Predator and MQ-9 Reaper RPA pilots who had cross-trained from a previous airframe (e.g., tanker, bomber, fighter, surveillance) to review and validate the list of theoretically organized attributes. Interviews included: (a) six RPA pilot flight CCs from ACC and AFSOC installations); (b) the Standards and Evaluations officers for the Wing and an MQ-9 Reaper squadron at an ACC installation; and (d) five RPA pilots from an ACC installation who provide oversight of SO training and supervision. During each interview, the list of attributes was discussed and operationally defined to ensure operators understood each attribute and standardization across interviews. Those attributes where there was not agreement by at least 90% of the participants were removed from the list.

RESULTS

The following tables represent the results of the attributes reported by SME's as important to training and operational performance and organized under the domains of: (a) physical health; (b) cognitive aptitude; (c) personality traits; and (d) motivation.

TABLE 1. Physical health attributes reported as critical to training and operational performance.

DOMAIN	ATTRIBUTE	OPERATIONAL DESCRIPTION
PHYSICAL HEALTH This domain refers to general physical health necessary to respond effectively to physical and environmental demands. Common aspects include: susceptibility to illness, visual or hearing difficulties, musculo-skeletal issues, general immunity, and physical fitness.	**General Health**	• No significant or chronic injuries, illnesses, or defects affecting performance (e.g., manual dexterity, vision, posture) or reliability. • Resilience to shift work adjustments
	Stamina	• Physical stamina for sitting and sustaining vigilance for extended periods • Postural strength & endurance • Resilience to physical & cognitive fatigue

Note: It is important to note the aeromedical standards required for performing RPA sensor operator duties is outlined in AFI 48-123, *section 6I— Ground Based Aircraft Controller.* These standards are higher than the traditional standards regarding fitness for military duties and world-wide deployment. The higher standards are reflective of the impact that physical health can have on the reliability of duty performance and the integrity of military operations. It is also important to note many SMEs reported the ergonomic design of the ground control station (GCS) was not well-suited for human performance and the requirement for sitting for long periods of time. For example, it was reported the chair in the GCS unit often lead to back pain after sitting for several hours. It was also reported that shift work changes, temperature control difficulties, and exposure to loud background noise from the cooling systems for the computers caused problems with fatigue.

TABLE 2. Cognitive aptitudes reported as critical to training and operational task performance.

DOMAIN	ATTRIBUTE	OPERATIONAL DEFINITION
COGNITIVE APTITUDE This domain refers to intellectual mental functions and information processing aptitudes essential to the acquisition of knowledge and skills across all major SO job accomplishments. Common facets of cognitive aptitude include: perception, attention, memory, spatial processing, and reasoning.	**Cognitive Proficiency**	• General cognitive ability • Speed & accuracy of information processing
	Visual Perception	• Visual acuity, scanning, & discrimination • Visual recognition, tracking, & analysis
	Attention	• Vigilance to multiple sources of visual & auditory information ***(situational awareness)*** • Sustained & divided attention to visual & auditory information
	Spatial Processing	• Spatial analysis & orientation • Spatial reasoning & construction ***(manipulation of 2-diminesional information into 4-dimensional mental imagery)***
	Memory	• Visual & auditory memory (working, immediate, & delayed) • Spatial memory (working, short-term, & delayed)
	Reasoning	• "Real time" general and deductive reasoning ***(problem solving)*** • Carefully & quickly assess risk, likely outcomes, & potential repercussions ***(forward thinking)*** • Quickly perceives the next steps and multi-tasks high level of information & procedures ***(task prioritization & management)***

Note: SMEs reported SOs who performed well in terms of timely skills acquisition and adaptation to the rigors and unique demands of the RPA platform appeared to possess high levels of the above cognitive aptitudes. It was perceived by SMEs that SOs who did not possess adequate levels of the above attributes struggled with timely skills acquisition, as well as task management and prioritization, situational awareness, channelized attention, and general problem solving. However, it is unclear at this time, which cognitive attributes from the above list have the *greatest* impact on performance and if lack of success was truly the result inadequate level(s) of cognitive aptitude(s).

TABLE 3. Personality traits reported as critical to training and operational performance.

DOMAIN	ATTRIBUTE	OPERATIONAL DEFINITION
PERSONALITY TRAITS This domain refers to non-cognitive capabilities and traits that effect SO duty performance and adaptation to the unique nature of RPA operations and community. Common elements related to performance include: general ability to identify and regulate emotions, positive self-regard, self-confidence, self-discipline, self-esteem, hardiness, impulse control, self-direction, general emotional disposition, and motivation to realize and act upon one's potentials.	**Composure**	• Remains composed & in control of behavior and emotions under stress. • Effectively compartmentalizes emotions
	Resilience	• Emotional stamina & hardiness in response to monotony, confined workspace, and high pressure situations
	Self-Certainty	• Clear sense of self-confidence • Clear sense of role as war-fighter • Maintains confidence during performance feedback
	Conscientiousness	• Deliberate, methodical, & organized • Self-disciplined
	Success Oriented	• Self-motivated & driven to succeed • Committed to self-improvement
	Perseverance	• Sustains a high level of effort over long periods of time despite hardships
	Decisiveness	• "Real time" decision making during monotony & high pressure situations
	Humility	• Effectively recognizes the need & asks for help • Seeks & accepts performance feedback from others
	Cohesiveness	• Values the role and supportive of other personnel • Participates in morale building exchanges
	Assertiveness	• Speaks up & effectively voices concerns in "real time" • Provides appropriate & decisive feedback
	Adaptability	• Generally flexible, realistic, & effectively responds to change and unpredictable stressors.

TABLE 4. Motivational Attributes Described as Critical to Training and Operational Performance.

DOMAIN	ATTRIBUTE	OPERATIONAL DEFINITION
MOTIVATION This domain refers to personal beliefs and intrinsic (internal rewards) factors that affect SO performance and longevity. Common elements of motivation include interest in the RPA mission and duties and advanced computer technology.	**Moral Interest**	• Motivated to save lives & protect U.S. & coalition forces • Personal beliefs and worldviews (spiritual, religious) support combat operations
	Occupational Interest	• Possess a sense of duty as a war fighter • Realistically understands & intrinsically appreciates RPA platform • *Enjoys duties of the position and contribution to daily operations in theater • *Strong intrinsic interest in advanced and emerging avionic RPA technology • *Strong interest in advancing national interests and mission objectives

Note: *Such attributes were not deemed critical to performance, but were deemed critical to retention and job satisfaction.

DISCUSSION

Critical Attributes According to RPA Operator Subject Matter Experts

As mentioned previously, the objective of the study was to identify psychological attributes perceived by SMEs as critical to successful skills acquisition in training and operational performance.

The MQ-1 Predator and MQ-9 Reaper SO attributes were categorized into: (a) Physical health (e.g., visual perception and postural endurance, physical reliability); (b) cognitive aptitude (e.g., higher than average cognitive proficiency with notable strengths in the areas of coordination, attention/vigilance, spatial-processing/analysis, reasoning/task prioritization, and situational awareness); (c) personality traits (e.g., ability to remain calm and composed in a data-intense environment, assertiveness, conscientiousness, humility, etc.); and (d) motivation (e.g., occupational passion and interest in RPA SO duties). It should be noted that occupational motivation was more associated with retention and job satisfaction. It was noted that many SOs did not necessarily enjoy or find much interest in their duties, but were capable of performing mission essential tasks. As a result, occupational motivation is critical to high performers and longevity, but according to SMEs not necessary for "adequate" performance.

Aside from the findings on the motivation domain, the results of this study reveal a significant overlap with the results of a previous study assessing the critical attributes of AC-130 Gunship SOs (Chappelle, Patterson, Sowin, & Randall, 2009). Consistent with the findings of the AC-130 Gunship study, there are a number of diverse yet necessary attributes SMEs reported as fundamental to the success of SO training and operational duties. Such attributes include higher than average capabilities in cognitive proficiency, visual-spatial processing, attention/vigilance, reasoning, emotional stamina, conscientiousness, and adaptability. The results suggest a biopsychosocial (multi-featured) approach is required to comprehend the diverse set of attributes critical to performance.

Physical Health and Fitness

The physical health and stamina of an individual plays a significant role in his or her performance according to SMEs. Although RPA SOs do not face the same physical rigors and dangers of flying as AC-130 Gunship SOs, their duties nonetheless are physically and mentally fatiguing. For instance, the MQ-1 Predator or MQ-9 Reaper SO faces the difficult task of sustaining attention and concentration in a visual and auditory data-intense environment with minimal changes in their immediate physical workspace. This sort of situation can create an element of monotony where keeping focused can be difficult. However, surveillance duties can be unpredictably interrupted by the exhilaration of "real time" combat operations and the request for weapon's deployment. Sustaining vigilance and heightened situational awareness with limited changes in the external environment and restrictions in personal space can lead to fatigue, which in turn can impair performance. It is essential an SO training candidate or incumbent be free from physical illnesses (e.g., sleep and pain disorders) or injuries (e.g., back pain, headaches) that could affect his or her reliability to sustain a heightened level of attention. It is also important an

SO training candidate or incumbent be free from any sort of physical difficulties that elevate fatigue and difficulty with adjusting to shift work (Tvaryanas, et al., 2006; Tvaryanas & MacPherson, 2009).

A crew member's ability to sustain appropriate postural positioning, hand-eye coordination, and other aspects of physical and psychomotor functioning are essential to the performance of his or her duties. However, it is possible that some musculo-skeletal injuries or disease processes that interfere with postural positioning may be mitigated via changes in the ergonomic design of seating, the computerized automation of procedures, and other aspects of the GCS.

It also stands to reason that based upon the high visual and auditory input of information coming from multiple sources, that any deficiencies in visual and auditory capabilities may become a major obstruction to the performance of SO duties. Any sort of disruption or disease process that interferes with hearing and vision should be scrutinized for the potential impact on performance.

In general, any sort of chronic illness or injury that requires continual treatment (such as medication) and interferes with posture, vision, hearing, information processing, and motor functioning may conflict with military readiness and the aeromedical criteria as outlined in Air Force Instruction (AFI) 48-123, *section 6I Ground Based Aircraft Controller* (2009). As a result, RPA SO training candidates should be fully screened prior to training to ensure they meet the required aeromedical standards.

Cognitive Aptitude

SMEs and evaluators inferred from the nature of SO duties that a high level of general cognitive ability and effective intelligence has a considerable role in successful performance, especially in time-critical situations (see Table 2). According to SMEs, it is essential that RPA SO trainees (and incumbents) do not have a history of (or currently struggle with) problems with attention and concentration, vigilance, reasoning, memory, visual-spatial aptitudes, or speed and accuracy of information processing (i.e., cognitive proficiency). SMEs reported that subtle deficits in these areas could potentially lead to problems during and following training. This became apparent from repeated conversations with SMEs who reported that SOs who had difficulties processing the complex amount of information within a time sensitive period struggled with vigilance, channelized attention, task management, task prioritization, situational awareness, reasoning, and task saturation. The importance of general cognitive ability, attention, vigilance, and visual-spatial aptitudes were also reported as attributes critical to selection in an earlier study of RPA MQ-1 Predator operators (Bailey, 2008) and could be easily inferred from the results of a comprehensive front-end task analysis of RPA Predator SO duties (Nagy, Eaton, & Muse, 2006). Such aptitudes could also be inferred from the results of a recently published taxonomy of knowledge and skills of RPA operators, in general (Pavlas, et al, 2009).

Additionally, screening for a history of illnesses (e.g., bacterial meningitis), physical injuries (e.g. closed head trauma), and developmental problems (e.g., learning disorder, attention deficit disorder) affecting a person's cognitive disposition is critical and should occur prior to any new recruit and enlisted airman being assigned to RPA SO duties. If a history of cognitive difficulties is discovered, it is essential that a SO training candidate (or incumbent) obtain a comprehensive assessment to determine the viability of an aeromedical waiver from Air Education and Training Command (AETC) so that a candidate may enter the training pipeline. The importance of cognitive functioning is becoming

increasingly critical as efforts to move to more advanced RPA airframes and multiple aircraft control (MAC) systems becomes apparent. For example, the RPA SO that is assigned to a MAC system will likely be required to manage and control the aircraft during certain aspects of flight (Nagy, Eaton, & Muse, 2006). This increased responsibility heightens the cognitive workload and demands of this position. Furthermore, the condensed time frame of training necessitates SO candidates are free from any sort of cognitive deficits or difficulties that would interfere with the timely acquisition of skills.

It should also be noted the demands of rotating shift work is a key aspect of RPA operations that can lead to mental fatigue (Walters, Huber, French, & Barnes 2002; Tvaryanas, Lopez, Hickey, DaLuz, Thompson, & Caldwell, 2006; Tvaryanas & Thompson, 2006) effecting performance. As a result, it is important an SO training candidate or incumbent have cognitive stamina. That is, the ability to sustain a heightened level of cognitive performance over lengthy uninterrupted periods of time (e.g., 8 to 12 hours) as well as during changes in shift work.

Personality Traits

As revealed via observations of the GCS, SOs are encapsulated within a data-intense environment stemming from multiple sources of auditory and visual input (e.g. phone, headset, instant messages, numerous screens, and multiple observers). SMEs reported the level of auditory and visual input and workload can be very taxing and stressful. As a result, there is a need for SOs to maintain a calm and composed demeanor and to have a high level of resilience to stress. Furthermore, SMEs reported that SOs must have emotional stamina, which they referred to as the ability to maintain a controlled temperament for lengthy periods of time. SMEs reported this trait was especially necessary for effectively managing the monotony of surveillance and reconnaissance activities, as well as the intense combat-related moments (e.g., close air support) that involve the deployment of weapons. SMEs further reported this trait was particularly important for managing the stress associated with integrating on a daily basis one's role as a war fighter with one's personal and domestic life. It is important to note that the results of a recent meta-analysis of studies using personality constructs to predict military aviation training outcomes reported emotional stamina (i.e., low levels of neuroticism) as a predictor of outcome performance (Campbell, Castaneda, & Pulos, 2010).

Consistent with the results of the study on AC-130 Gunship SOs (Chappelle, Patterson, Sowin, & Randall, 2009), a person who is overly self-conscious, lacking in self-confidence or has a significant history of emotional difficulties is likely not well-suited for the occupational demands of RPA operations. Areas of concern include behavioral impulsivity and problems controlling anxiety, depression, anger, and other negative emotional states. It was repeatedly emphasized by SMEs that an individual with any of the aforementioned difficulties will likely have adjustment-related difficulties when adapting to the rigors and uniquely stressful demands of the position. It is also noted, that according to aeromedical standards, any person with a history of emotional or behavioral difficulties (e.g., depression, anxiety, and adjustment disorder) as outlined in AFI 48-123, *section 6I Ground Based Aircraft Controller* (2009) must have an aeromedical assessment prior to being considered for SO duties. This process is particularly important given the nature of serving as a war fighter performing "tip of the spear" aerial operations in theaters of conflict while simultaneously having to balance the demands of one's personal life and relationships in a peaceful environment.

Self-confidence and having a sense of self-certainty in one's ability and role as a war fighter were traits consistently discussed by SMEs as critical to the success of RPA SOs during and following training. When it becomes necessary for an individual to deploy weapons, it is essential the SO is confident in his or her skills. According to SMEs, second guessing one's ability and role as a war fighter, especially in a time-sensitive and critical situation, could potentially lead to group fragmentation and dissent, as well as mission failure (e.g., loss of surveillance, loss of a combat advantage). It was frequently reported by SMEs that a SO who displays a high level of self-confidence without being arrogant tends to foster team cohesiveness among other crew members (e.g., pilot and mission intelligence coordinator). It was also reported that SOs with a high level of self-certainty are more likely to successfully deploy weapons and effectively complete missions. The ability to be self-confident and remain composed in a data-intense environment was repeatedly reported by SMEs as personality traits of the more successful RPA SOs. However, it is likely that high self-confidence and self-certainty (as well as emotional composure) among SOs is a combination of existing traits fostered by training and an interpersonally supportive environment.

There was also the trait of being decisive in making "real-time" decisions during monotonous and high pressure situations. It was often reported by SMEs that SOs who performed well were clear in their decisions related to following procedures and checklists, providing clear feedback during radio and verbal chat, clarifying comments or remarks from others, and making clear statements about surveillance, reconnaissance, and targeting tasks. It should also be mentioned that decisiveness among high performing SOs is likely a combination of existing traits fostered by training and effective crew resource management.

According to SOs, the deployment of weapons also requires well developed skills for compartmentalizing their emotions. The rigors of training and operational demands of the RPA platform (e.g., targeting and destruction of enemy assets, taking the lives of enemy combatants, as well as surveillance of battle damage) can be emotionally taxing. SMEs reported the ability to compartmentalize the emotional rigors of one's job in order to conserve emotional reserves when returning home from work or interacting with others outside the military installation can be an important trait for long term stability. It is well-known that resilience to stress and emotional difficulties (often known has psychological hardiness) is considered a core attribute of those within high risk military occupations (Picano, Williams, & Rolland, 2006).

It was also reported that a high level of conscientiousness, perseverance, and success-oriented character traits appeared to distinguish SOs who acquired skills in a timely fashion and who received higher performance ratings. It was reported by SMEs that SOs with such characteristics tended to be more deliberate and methodical in their habits, and show more initiative toward studying and performing. Of the many different personality traits that have been studied, conscientiousness is considered a reliable predictor for the acquisition of job knowledge and performance across a wide range of occupations (Barrick & Mount, 1991, Schmidt & Hunter, 1998), and deemed important for high-risk operational military positions (Picano, Williams, & Rolland, 2006). SMEs reported that SOs with high levels of conscientiousness (e.g., self-disciplined, committed toward self-improvement, driven to succeed, achievement oriented) clearly excelled and distinguished themselves from those who had motivational and performance-related difficulties.

The interpersonal attributes consistently emphasized by SMEs included assertiveness, humility, and cohesiveness. These findings are consistent with the results of the study assessing AC-130 Gunship SOs (Chappelle, Patterson, Sowin, & Randall, 2009). A person with a history of interpersonal difficulties

in the above areas may not possess the character traits necessary for adapting to the unique interpersonal demands and atmosphere of RPA operations that involve both ISR and weapon's deployment duties.

It is important to note that SMEs reported that having a sense of cohesiveness with other crew members (e.g., pilot, mission intelligence coordinator) was critical to performance. They reported cohesiveness as being comfortable working with others within a confined workspace, trusting other crew to fulfill their roles, effectively listening and considering the input of others, and valuing the role of others in all aspects of RPA operations. Although valuing and responding to the feedback of others was an attribute that can be nurtured through training and leadership, the notion of being comfortable working with others in a confined space, according to SMEs seemed to come natural to those who did well in training and afterwards.

The interactional style and manner of communication in a stressful and demanding environment may make the difference between a successfully completed mission and a costly mishap (e.g., the inadvertent injury or loss of human life, and interruption to sensitive high-risk military operations). According to SMEs, individuals that tend to be assertive when speaking often have better working relationships. Assertive communicators were described as those SOs that appropriately speak up (and challenge others) when necessary. They tend to offer clear, timely, and decisive feedback to others (regardless or rank or position of authority) and when appropriate, provide timely criticism. According to SMEs, SOs that tend to have an aggressive (e.g., loud, angry, boisterous) or passive (e.g., quiet, meek, subdued) style of relating others tend to struggle with developing efficient crew resource management skills and have greater difficulty adjusting to the interpersonal milieu of RPA operations. This is another trait identified as critical to performance that may be fostered through training and leadership, and considered during selection.

Although a high level of confidence was reported as critical to performance, so was having a sense of humility. That is, a willingness to ask for help when needed, the ability to recognize and learn from mistakes, and to accept performance feedback from co-workers, as well as supervisors. SMEs reported those who were confident, but also humble were perceived as being more likely to excel in training and afterwards in both leadership and operational duties.

Another trait considered critical to performance by SMEs is adaptability. SMEs defined adaptability as the ability of RPA SOs to effectively respond to situational stressors and life events (e.g., daily worries and life stressors) that might interfere with performance. Adaption to predictable and unpredictable life events (e.g., financial, legal, family, and personal stressors) and hassles is complex. Even with excellent skills in one's ability to manage stressors, there is the potential for a single event (or series of events) to be emotionally disruptive and affect a person's ability to appropriately perform his or her duties. What appears to be most important according to SMEs, is the SOs ability to respond and effectively manage these events. This is particularly important when having to balance the needs and issues of one's personal-social life with the needs and demands of RPA operations. It was mentioned repeatedly by SMEs, there was a level of uncertainty regarding how well young, first-term airmen, straight out of basic military training, will respond to managing and balancing personal life events and daily stressors from interfering with the inherent demands of RPA operations. There was a strong preference from SMEs for SO training candidates who demonstrate a high level of general maturity.

There is a significant amount of overlap in the interpersonal characteristics deemed necessary for performance between AC-130 Gunship SOs (Chappelle, Patterson, Sowin, & Randall, 2009) and RPA MQ-1 Predator and MQ-9 Reaper SOs (e.g., conscientiousness, success-orientation and humility). These preliminary findings from interviews with SMEs suggest that precision strike platforms (whether manned or unmanned) require a distinguished set of personality traits. However, it does not indicate that an enlisted airman who does well in the AC-130 Gunship will also perform well if assigned to an RPA platform. Although a person may have the cognitive and emotional-interpersonal attributes to succeed, an additional attribute SMEs identified as affecting performance is an airman's motivation. That is, his or her occupational interest and passion for the duties he or she is assigned.

Occupational Motivation

According to SMEs, it is important a person have strong and appropriate occupational motivation. Depending upon many factors (e.g., length of military service, voluntary versus non-voluntary placement), it can be difficult to increase or instill motivation in an individual in the RPA SO career field. Furthermore, if an individual is highly interested in traveling abroad, in-person interpersonal exchanges with various groups and units, and engaging in novel missions with risks to personal safety (e.g., aspects of operations within the AC-130 Gunship platform), then he or she will likely struggle with motivational difficulties if assigned ground-based duties. In part, because RPA operations require minimal mobility, (unless serving as part of a launch and recovery element) and risk to personal safety.

Consistent with the findings of the AC-130 Gunship SO study (Chappelle, Patterson, Sowin, & Randall, 2009), the motivation domain was separated into the facets of moral and occupational interest. The moral interest component was explained by SMEs as a personal belief system that is compatible with RPA duties, the role of RPA operations in theater, and the deployment of weapons. Furthermore, SMEs reported it was essential SOs interested in the deployment of weapons stems from the desire to protect and save lives. Several SMEs reported a clear difference in the maturity and performance of those individuals focused on protecting U.S. and allied forces, than those focused primarily on destroying enemy combatants and assets.

Furthermore, some airmen may emotionally struggle with their role in the killing of enemy combatants. Interviews with SMEs reported a small number of incidences (i.e., four to five) of SOs voicing their discomfort with their duties and/or requesting to leave the career field after their role in the deployment of weapons. They reported such SOs performed their surveillance and reconnaissance duties well, but emotionally struggled with their role in taking the lives of others, regardless of the threat enemy combatants posed to U.S. and allied forces. SMEs reported such SOs experienced significant internal conflict with their role, and that such a conflict did not become apparent until the SO was faced with a real-life situation or fully educated about the nature of their combat-related duties. It is important to ensure that airmen selected for RPA SO duties are fully aware of, and understand, their role in the targeting and destruction of enemy combatants and assets prior to entry into training. It is likely that some SO candidates will decline the opportunity to pursue such duties once they fully understand their role in precision strike operations.

One facet of occupational motivation is labeled occupational interest. Occupational interest is more than just zeal or excitement about one's job. Occupational interest is both a realistic understanding and an appreciation of the RPA platform and duties. The RPA SO that possess this characteristic demonstrates a high level of interest in the mission and in the support of joint operations. It appears that being a team player is important to the RPA SO, because in addition to enjoying joint operations, a critical part of job passion is the enjoyment RPA SOs find in the support of reconnaissance and precision strike operations. According to SMEs, the RPA SO that has these characteristics at the onset of training is likely to report higher job satisfaction, more cohesiveness amongst crew members, and is likely to stay in the career field longer than those with little or no occupational interest.

The finding that motivation, such as a compatible belief system and interest in RPA duties has a key role in performance has implications in the assessment of aeromedical adaptability for RPA SO duty by flight surgeons. If there are significant concerns regarding motivational issues that would negatively affect performance, an SO candidate or incumbent may be disqualified from his or her RPA duties in accordance with AFI 48-123 (2009) section 6I, 6.46.15.2.

Recommendations for Aeromedical Assessment of Training Candidates

The Chief of Staff of the Air Force plans to significantly increase the number of RPA operations in theater over the next three years (V. Allen, personal communication, 15 Sep 2009). The SO career field is significantly undermanned. As a result, (and as previously noted), the USAF has responded by developing a SO training pipeline for first term airmen coming straight out of basic military training (BMT). However, any basic airman that completes the SO training pipeline, but does not meet aeromedical standards places a significant burden on other RPA SOs to make up the increasing short fall in manpower. As a result, the importance of aeromedically screening enlisted airmen and new recruits prior to being selected for SO training and duties cannot be underscored enough.

Discussion with SMEs indicate in order to best address the plethora of attributes reported as critical to successful training and performance, the aeromedical assessment and selection evaluations of training candidates will need to take a biopsychosocial/multimodal approach. Unlike the moderately small number of prospective SOs for the AC-130 Gunship, the RPA SO training pipeline is faced with having to train over 100 individuals each year. As a result, the cost for implementing an assessment and selection program for RPA SOs is likely much higher. However, despite the large number of enlisted airmen going through the training pipeline, it stands to reason that identifying airmen at high risk of training and adaptation problems is less costly than having to manage the disruption to operational capabilities from airmen who are assigned to such duties but fail to adequately adapt.

Aeromedical Screening

The ability to accurately predict the success an individual will have in a training program or to determine the level of attainment they will reach is extremely difficult. However, for the RPA SO position, the ability to use instruments to "screen out" candidates is especially favorable. The early identification of SO training applicants that do not meet the aeromedical standards or waiver criteria as outlined in Air Force Instruction (AFI) 48-123, *Section 6I Ground Based Controller duties* (2009) and/or

those whose disposition is incompatible with the rigors of RPA operations can save significant amount of time and money. A prescreening questionnaire with items that identify those conditions that are aeromedically disqualifying is an inexpensive and efficient place start to the process of identifying training candidates unsuitable or unfit for SO duties. It is also recommended that, prior to selection, the medical records and history of training candidates are reviewed by medical personnel. If there is strong evidence for physical, cognitive, emotional, behavioral, or interpersonal difficulties, the training applicant would require an additional evaluation by a medical provider to determine if a more thorough aeromedical evaluation (and possibly a waiver) is needed.

Computer-Based Psychological Testing

To assist in the identification of those individuals at risk of problems if selected for RPA SO duties, the administration of objective psychological testing can be very beneficial. The recognition of applicants with significant psychological problems, deficits, or incompatible character traits (e.g., schizoid, avoidant, schizotypal traits) allows removal from the selection pool without having to conduct a more time-intensive and hence costly interview. The selection of tests and measures depends to some extent on the resources available for assessing personnel, the amount of time an evaluator has to assess each applicant, as well as the format of the evaluation setting (group vs. individual). Below is a discussion of considerations when attempting to put together a thorough psychological test battery for selecting RPA SOs.

As mentioned previously, general cognitive ability must be assessed when evaluating prospective applicants for RPA SO training. Effective intelligence and general cognitive ability are often excellent predictors of job performance because of their direct impact on the acquisition of job knowledge. Scores from the Air Force Qualifying Test may be obtained to identify those who are in the upper echelon (e.g., upper 10%) of cognitive functioning of USAF enlisted applicants. The AFQT is already used to determine whether individuals have a certain level of cognitive ability in order to pursue aviation and aircrew platforms. However, the AFQT may not measure visual-performance and spatial based aptitudes as well as desired. If intellectual testing is going to be used, visual-spatial performance measures are likely key to the selection of medically fit RPA SO training candidates. Because the SO career field is in its infancy, there is minimal data to support or indicate which assessment instruments are the most appropriate. Regardless of the instrument chosen; it is essential the evaluating clinician use measures which are empirically validated, culturally unbiased, and supported by substantial research.

It would be helpful to acquire objective psychological testing that assesses both the presence of pathology, as well as the normal dimensions of personality (Cattell, et al., 1993; Costa & McRae, 1995). As previously discussed, using objective testing instruments in the assessment of RPA SO training candidates is crucial for identifying aspects of a candidate's psychological disposition that are diagnostic in terms of clinically significant emotional or behavioral difficulties and likely maladaptive to RPA SO duties. Furthermore, the assessment of personality is considered a key component to selecting high-risk, high demand personnel (Picano, Williams, & Roland, 2006). Regardless of the measures used above, assessing the attribute of conscientiousness has been repeatedly demonstrated to correlate with job performance and may improve the incremental validity of a selection decision when combined with measures of general intellectual functioning and cognitive ability (Schmidt & Hunter, 2004).

Structured Clinical-Occupational Interview

Psychological interviews for the RPA SO occupation can be either structured or unstructured. Conducting an unstructured interview involves inquiries with no set of specific question or procedures while still attempting to gather information. There is no process in place to score the responses and often different questions are given to different candidates. The assessment is derived from subjective impressions and the evaluator's conclusions. This type of interview tends to be unreliable in terms of empirical evidence. In comparison, the structured clinical interview tends to be more empirically valid and has preset questions that are generally based on a job analysis. Although structured interviews are more costly to construct and use, they are also significantly more valid than unstructured interviews (Schmidt & Hunter, 2004). As a result of the need for increased incremental validity because of the sensitive nature of high risk operational duties, it is highly recommended a structured clinical occupational interview be developed for assessment and selection purposes. At minimum, the interview should address the domains and corresponding attributes in Tables 1 – 4 and previously discussed. A meta-analysis of 85 years of psychological studies on assessment methods found that structured interviews added significantly to the predictive validity of selection decisions- especially when combined with measures of general cognitive ability (Schmidt & Hunter, 1998). It should be noted that interviews, in addition to psychological testing, are common place for airmen entering into sensitive positions (such as survival school, sniper training, or basic military instructor training).

As noted previously, even resilient personnel are likely to face a series of life stressors or a clustering of problems at some point during their careers that lead to a moderate or severe impact on their occupation. What appears to be most important according to SMEs is the SO's ability to respond to or effectively manage these events. In order to identify aeromedically qualified candidates it is important to look at the presence of life stressors and events that may distract an individual from completing training or adequately adapting to the unique aspects of the RPA platform. It is important to bear in mind that the timing and number of significant life stressors or other transient problems may be a cause of concern due to the impact on a person's psychological disposition. A thorough interview should address the potential impact the frequency and chronicity of such stressors will have on his or her ability to effectively complete training and afterwards.

In accordance with assessment and selection purposes, the aeromedical evaluation of an RPA SO for the consideration of a waiver should take on a biopsychosocial approach. An assessment should take into account the critical attributes listed in Tables 1 - 4 and include clinical interviewing, comprehensive and objective psychological testing, and observations from others within their chain-of-command. It is important to gather additional information from others with regular contact with the person in an effort to validate behavioral reports and observations obtained during the assessment process.

Limitations of the Study

At present, there are several limitations to the current list of critical psychological attributes and recommendations of the assessment and selection program. First, demand characteristics or observer dependency refers to an experimental artifact where participants unconsciously change their behavior based on what the expectations (or demands) of the experimenter may happen to be. However,

sampling of several SME from various disciplines and squadrons from both ACC and AFSOC installation and the consistency of results increased confidence and validity of the findings. Second, phrasing of questions during the interviews may have affected the way in which participants respond. However, every attempt was made to "go beyond" surface answers to examine the subtleties and nuances of the participants' comments. Third, perceived lack of anonymity may have affected disclosure, particularly in focus groups. As a result, SMEs may not have felt free to be candid or mention certain topics. To mitigate possible "chilling" effects, commanders were not present during individual and focus group interviews. Furthermore, participants were encouraged to speak freely at interviews and in group sessions and their rights to confidentiality respected. Fourth, the critical attributes listed have not been validated by performance-based job measures and regression analyses of objective psychological testing. Despite the rigors of identifying the attributes and placing them into appropriate theoretical categories, additional research using objective psychological tests and well-developed performance ratings is needed to substantiate the list of critical attributes and to determine the amount of impact that each attribute has on general performance. Until such research is completed, these characteristics are considered with caution. Fifth, the recommendations of using a pre-screen, standardized clinical interview and psychological testing can be a costly process. Additional research is needed to determine how well interview forms and psychological tests (e.g., cognitive and personality) predict training success and future performance. For example, does the estimated full scale intelligence test scores obtained from existing Air Force Qualifying Test (AFQT) scores serve as a similarly effective measurement as the administration of a standardized, commercial intelligence test. Sixth, another step in the process of validating the critical attributes is to obtain performance based data using evaluator rating forms based upon behavioral anchors and critical incidents that operationally define the critical attributes and distinguish functioning incumbents from training failures. Such data can be used for regression analyses to eliminate items on pre-screen and clinical interviews, as well as tests that are marginally related to performance. This process may reduce administration time and other costs associated with conducting an assessment and selection program.

CONCLUSION

MQ-1 Predator and MQ-9 Reaper SOs are considered to be in a high-risk, high-demand, high-precision military position and pivotal to successful force protection, reconnaissance, and precision strike operations. Based upon the results of interviews with SMEs and discussions with SOs, there is an overlap in the critical attributes with other sensitive, high-risk military positions. An assessment and selection program selecting out candidates who are not suitable for the position may be centered on the critical attributes reported by SMEs and theoretically organized in Tables 1 - 4. Such a template provides a frame of reference for the selection of tests, measures, and structured interviews for aeromedical evaluations and the development of an RPA SO assessment and selection program.

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APPENDIX A-STANDARDIZED QUESTIONS INCLUDED IN SME OPERATOR INTERVIEWS

Describe the qualities of enlisted airmen who have performance related problems in training?

Describe the qualities of enlisted airmen who succeed in training and adapt to the operational demands of their duties?

What sort of cognitive aptitudes are necessary for successful training and adequately adapting to operational demands?

What sort of cognitive aptitude problems distinguish training failures or those who have difficulty adapting to the operational demands?

What sort of personality traits and characteristics are necessary for successful training and adequately adapting to operational demands?

What sort of personality traits and characteristics distinguish those who do well performing their operational tasks from those who struggle and have chronic difficulties?

What sort of interpersonal traits and characteristics are necessary to successful performance of SO duties and adaptation to the RPA platform?

What sort of interpersonal traits and characteristics distinguish training failures or those with performance problems?

What sort of tasks and demands of the RPA platform are distinct from the tasks and demands of SO duties in a manned aircraft (i.e., AWACS, JSTARS, AC-130, MC-130)?

What differences in attributes affecting performance are their between airmen coming from different accession sources?